PCT/AU2004/000748

Australian Government

REC'D 22 JUN 2004	
WIPO	PCT

Patent Office
Canberra

I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003902843 for a patent by GSA INDUSTRIES (AUST) PTY LTD. as filed on 06 June 2003.

COMMONWEALTH OF AUSTRALIA
AUSTRALIA
PATENT OFFICE

WITNESS my hand this
Sixteenth day of June 2004

J. Billingsley

JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
SUPPORT AND SALES

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

P/00/009
Regulation 3.2

AUSTRALIA
Patents Act 1990

PROVISIONAL SPECIFICATION

Invention Title: THERMOSTATIC MIXING VALVE

Applicant: GSA INDUSTRIES (AUST) PTY LTD

The invention is described in the following statement:

THERMOSTATIC MIXING VALVE

FIELD OF THE INVENTION

The present invention relates to a thermostatic mixing valve.

BACKGROUND OF THE INVENTION

Thermostatic mixing valves enable hot and cold fluids, typically water, to be accurately mixed so as to deliver fluid at a desired temperature to the valve outlet. One form of thermostatic mixing valves adopts a "T" pattern in which the hot and cold water enters through inlets in the arms of the "T" and the mixed water exits through an outlet in the base of the "T". Another form of thermostatic mixing valve adopts an "L" pattern in which the hot and cold fluid inlets are orientated at right angles to each other.

One of the problems with such mixing valves is that their design is complicated by the need to provide a mechanism for allowing for any continued expansion of the thermostatic element after the flow of hot and cold fluids is adjusted. This problem has been addressed in "T" pattern thermostatic mixing valves by including a spring arrangement adjacent to the leading end of the thermostatic valve. The inclusion of such an arrangement requires an extra opening to be formed in the housing and also increases the part and production costs for the valve.

Another problem with such mixing valves is that to enable adjustment of the rest position of the thermostatic element, additional constructional features or components have to be provided. This inevitably increases the cost of the mixing valve.

The present invention seeks to provide an improved thermostatic mixing valve.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention there is provided a thermostatic mixing valve including a housing having a first fluid inlet, a second fluid inlet and a fluid outlet, a mixing chamber located between the respective fluid inlets and the fluid outlet, a piston arrangement arranged to regulate the flow of the first and second fluids from their respective inlets into the mixing chamber, a thermostatic element located in or adjacent to the mixing chamber and a mixing tube arranged to direct the flow of first and second fluids onto the thermostatic element, and wherein the mixing tube includes an adjustment mechanism for adjusting a rest position of the thermostatic element.

Preferably, the adjustment mechanism is arranged to adjust the positioning of the thermostatic element relative to the piston arrangement so that a set temperature of the fluid through the fluid outlet can be varied.

Preferably, adjustment of the adjustment mechanism results in a change in the flow of fluid from the respective hot and cold fluid inlets into the mixing chamber so that the set temperature of the fluid flowing through the fluid outlet is adjusted.

In one form of the invention, the mixing tube is configured to seat a trailing end of the thermostatic element, whilst a leading end of the thermostatic element is arranged to contact a portion of the piston arrangement. The adjustment mechanism may include a thread arrangement formed on the periphery of the mixing tube which is arranged to engage with a thread formed in the sidewall of the mixing chamber. Such a thread arrangement enables the mixing tube's positioning within the mixing chamber to be adjusted relative to the piston arrangement by rotating the mixing tube.

Alternatively, the adjustment mechanism may enable the size of the mixing tube to be varied so that it can be located in one of a series of seats formed in the sidewall of the mixing chamber.

In either form of the invention, adjustment of the adjustment mechanism preferably takes place during manufacture or installation of the thermostatic mixing valve via access through the fluid outlet.

According to a second aspect of the invention there is provided a thermostatic mixing valve including a housing having a first fluid inlet, a second fluid inlet and a fluid outlet, a mixing chamber located between the respective fluid inlets and the fluid outlet, a piston arrangement arranged to regulate the flow of the first and second fluids from their respective inlets into the mixing chamber, a thermostatic element located in or adjacent to the mixing chamber and an adjustment mechanism for adjusting a rest position of the thermostatic element.

Preferably, the adjustment mechanism includes an adjustment pin. The adjustment pin is threadedly connected to the housing of the thermostatic mixing valve. The adjustment pin is configured so that an inner portion of the pin is in contact with the trailing end of the thermostatic element and an outer end of the pin is accessible from the outside of the housing thereby enabling movement of the pin. The pin is configured so that movement thereof, for example rotation, results in an adjustment in the positioning of the thermostatic element relative to the piston arrangement.

In a preferred form of either aspects of the invention, a check valve is mounted adjacent each of the hot and cold fluid inlets to prevent back flow of fluid through the respective inlets.

Preferably, the first fluid inlet is a cold fluid inlet and the second fluid inlet is a hot fluid inlet.

In accordance with one embodiment of the first and second aspects of the invention, the piston arrangement is mounted within the housing and includes a partition, a valve and a spring. The valve includes a socket for engaging with the thermostatic element, a bore and a first and a second end. The first end of the valve and the periphery of the partition define a flow path through which hot fluid can pass through the bore of the valve and into the mixing chamber. Flow of hot fluid through the valve is throttled by the partition sealingly engaging against the internal bore of the valve. Seal means are provided between the periphery of the partition and the bore of the valve.

The second end of the valve and a seat ("the cold seat") formed in the sidewall of the housing define a flow path through which cold fluid can pass into the mixing chamber. Flow of cold fluid into the mixing chamber is throttled when the second end of the valve is located against the seat formed in the housing (i.e. "the cold seat").

The socket is arranged to receive the leading end of the thermostatic element so that expansion of the thermostatic element results in the valve moving away from the cold seat. This provides greater flow of cold fluid into the mixing chamber and proportionally decreases the flow of hot fluid into the internal bore of the valve. The spring is configured to bias the valve towards the cold seat. Accordingly, when the thermostatic element contracts the action of the spring bias will result in the valve moving towards the cold seat. This will enable a greater flow of hot fluid into the bore of the valve and into the mixing chamber and a proportional decrease in the flow of cold fluid into the mixing chamber.

The present invention also provides a method of adjusting the temperature of an outlet fluid through a thermostatic valve, said thermostatic valve including a housing having a first fluid inlet, a second fluid inlet and a fluid outlet, a mixing chamber located between the respective fluid inlets and the fluid outlet, a piston arrangement arranged to regulate the flow of the first and second fluids from their respective inlets into the mixing chamber, a thermostatic element located

in or adjacent to the mixing chamber and an adjustment mechanism for adjusting the rest positioning of the thermostatic element relative to the piston arrangement, said method including the step of adjusting the adjustment mechanism so as to adjust the rest position of the thermostatic element relative to the piston arrangement to thereby change the flow of the first and second fluids into the mixing chamber until the temperature of the outlet fluid through the fluid outlet is at a desired set temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

Embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:-

Figure 1 is a cross sectional view of a thermostatic mixing valve in accordance with a first aspect of the invention;

Figure 2 is a cross sectional view of a thermostatic mixing valve in accordance with a second aspect of the invention; and

Figure 3 is a cross sectional view of the thermostatic mixing valve shown in Figure 2 at 90º rotation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 illustrates a thermostatic mixing valve 10 in accordance with an embodiment of the first aspect of the invention. The valve 10 includes a housing 12, a cold fluid inlet 14, a hot fluid inlet 16 and a mixed fluid outlet 18. As is evident from Figure 1, the cold fluid inlet 14 and the hot fluid inlet 16 are orientated in an "L" shape so that the cold and hot fluid inlets 14, 16 are orientated at right angles to each other.

Located within the housing 12 adjacent to each of the cold and hot fluid inlets 14, 16 is a respective check valve 20. Each check valve 20 is arranged to prevent inadvertent backflow of fluid through the respective cold and hot inlets 14, 16. It will be appreciated that although it is desirable to include such a check valve 20 adjacent each of the cold and hot inlets 14, 16 it is not essential to a proper working of the thermostatic mixing valve 10.

Located between the respective cold and hot fluid inlets 14, 16 is a piston arrangement 22. The piston arrangement 22 is located within the housing 12 and is configured so that it can regulate the flow of cold and hot fluid from their respective cold and hot fluid inlets 14, 16 into a mixing chamber 24. A thermostatic element 26 is located in the mixing chamber 24 between a mixing tube 28 and the piston arrangement 22. The mixing tube 28 is arranged to direct the flow of hot and cold fluid onto the thermostatic element 26. An adjustment mechanism, which will be described in more detail below, is formed as part of the mixing tube 28 and is arranged so that upon adjustment thereof, the mixing tube 28 moves in a direction towards or away from the hot fluid inlet 16, thereby adjusting the rest position of the thermostatic element 26. A change in the rest position of the thermostatic element 26 results in a change in the positioning in the piston arrangement 22. This in turn results in a change in the set flow of fluid from the respective cold and hot fluid inlets 14, 16 into the mixing chamber 24. This change in hot and cold fluid flow results in the set temperature of the fluid flowing through the fluid outlet 18 being adjusted. The manner by which the flow of fluids from the respective cold and hot inlets 14, 16 to the mixing chamber 24 is varied by the piston arrangement 22 will be described in more detail below.

The piston arrangement 22 includes a partition 30, a valve 32 and a spring 34. The valve 32 includes a socket 36 for engaging with a leading end 26a of the thermostatic element 26, a bore 38 in which the spring 34 is positioned, a first peripheral end 40 and a second peripheral end 42.

The first peripheral end 40 of the valve 32 and the periphery of the partition 30 define a flow path through which hot fluid can pass through the bore 38 of the valve 32 and into the mixing chamber 24. Flow of hot fluid through the valve 32 is throttled when the partition 30 sealingly engages against the internal wall 38a of the bore 38 of the valve 32. A seal 44, in the form of at least one O-ring, is located on the periphery of the partition 30 to provide a sealed engagement with the internal wall 38a of the bore 38. The use of other forms of seal is envisaged.

The second end 42 of the valve 32 is configured to engage in a seat 46 formed in the sidewall of the housing 12 of the thermostatic valve 10. For ease of further description the seat 46 will be referred to hereafter as the cold seat 46. The second end 42 of the valve 32 and the cold seat 46 define a flow path through which cold fluid can pass from the cold inlet 14 into the mixing chamber 24. Flow of cold fluid into the mixing chamber 24 from the cold inlet 14 is throttled when the second end 42 of the valve 32 is located firmly against the cold seat 46 formed in the housing 12. The spring 34 is biased to push the second end 42 of the valve 32 onto the cold seat 46 and to balance the force of the thermostatic element 26.

In accordance with the embodiment shown in Figure 1, the mixing tube 28 includes a socket or seat 50 which is arranged to receive a trailing end 26b of the thermostatic element 26. Thus, as depicted in Figure 1, the thermostatic element 26 is located between and in contact with both the mixing tube 28 and the piston arrangement 22.

In the arrangement shown in Figure 1, the adjustment mechanism takes the form of a screw thread 52 formed on the outer periphery of the mixing tube 28. The screw thread 52 is arranged to engage with a corresponding thread 54 formed on the internal wall of the housing 12. Accordingly, when the mixing tube 28 is rotated along the thread 54, the positioning of the mixing tube 28 and the connected thermostatic element 26 is adjusted in a direction towards or

away from the hot inlet 16. When the positioning of the thermostatic element 26 is adjusted there is an adjustment in the positioning of the piston arrangement 22. For example, if the mixing tube 28 and the connected thermostatic element 26 are adjusted so as to move them towards the hot inlet 16, the piston arrangement 22 will also be moved towards the hot inlet 16. Thus, the second end 42 of the valve 32 will be moved away from the cold seat 46, allowing an increase in the flow of cold fluid from the cold fluid inlet 14 into the mixing chamber 24. At the same time there will be a decrease in the flow of fluid through the path defined between the first end 40 of the valve 32 and the partition 30 and thus there will be a decrease in the flow of hot fluid into the mixing chamber 24. This will result in a reduction in the set temperature of the mixed fluid exiting the fluid outlet 18.

From the above description it will be appreciated that during manufacture or installation of the thermostatic mixing valve 10 it is possible to adjust the positioning of the mixing tube 28, thereby adjusting the rest position of the connected thermostatic element 26. This will result in an adjustment to the set temperature of the mixed fluid exiting the fluid outlet 18 during use thereof.

During use of the thermostatic mixing valve 10 cold fluid will enter the cold inlet 14 and hot fluid will enter the hot inlet 16. Unless the piston arrangement 22 is positioned to throttle one of the hot or cold fluid paths, both hot and cold fluid will enter the mixing chamber 24 to surround the thermostatic element 26 and then exit the outlet 18. Depending on the temperature of the mixed fluid within the mixing chamber 24, the thermostatic element 26 will remain as it is, expand or contract. If the temperature of the fluid contacting the thermostatic element 26 is at the desired set temperature, the thermostatic element 26 will remain as it is and there will be no adjustment in the flow of hot and cold fluid into the mixing chamber 24. If the temperature of that fluid is too hot, the thermostatic element will expand so as to cause the valve 32 of the piston arrangement 22 to move in a direction towards the hot inlet 16 against the bias of the spring 34. This will result in the second end 42 of the valve 32 moving away from the cold

seat 46 and thus the flow of cold fluid into the mixing chamber 24 will increase. At the same time there will be a reduction in the flow of hot fluid through the fluid path defined by the first end 40 of the valve 32 and the partition 30. Accordingly, this will result in the temperature of the mixed fluid within the mixing chamber 24 being reduced.

If the temperature of the fluid contacting the thermostatic element 26 is too cold, the thermostatic element 26 will contract and there will be an increase in the flow of hot fluid and a decrease in the flow of cold fluid into the mixing chamber 24.

It will be appreciated that the thermostatic element 26 will continue to react to the temperature of the fluid contacting it and as a consequence the valve 32 will continue to move so as to regulate the flow of cold and hot fluids into the mixing chamber 24. This regulating effect of the cold and hot fluids into the mixing chamber 24, by virtue of the movement of the valve 32 of the piston arrangement 22, will continue during use of the valve 10. In this manner, the thermostatic mixing valve 10 will act to control the temperature of the fluid exiting the fluid outlet 18 to the set temperature. Provided the temperature of the cold and hot fluids entering the respective cold and hot inlets 14, 16 is reasonably constant, the positioning of the valve 32 relative to the cold seat 46 will eventually be stabilized.

Figures 2 and 3 illustrate an embodiment of the second aspect of the invention. In this embodiment the thermostatic mixing valve 100 has a similar form to that illustrated in the first embodiment, with the exception that there is no mixing tube 28 and the adjustment mechanism adopts a different form. In this second embodiment, the adjustment mechanism takes the form of an adjustment pin 128.

The adjustment pin 128 is located within the housing 12 of the thermostatic mixing valve 100 so that it extends substantially perpendicularly to the

longitudinal axis of the thermostatic element 26. The adjustment pin 128 has an inner portion 128a which is arranged to contact with the trailing end 26b of the thermostatic element 26. The adjustment pin 128 also has an outer end 128b which is accessible from the outside of the housing 12 of the thermostatic mixing valve 100. The pin 128 is configured and arranged within the housing 12 so that rotation of the adjustment pin 128 results in movement of the thermostatic element 26 either towards or away from the hot fluid inlet 16. This movement of the thermostatic element 26 results in a related movement of the piston arrangement 22 within the housing 12 in a similar manner to that described previously above in relation to first embodiment of the invention.

As shown in Figures 2 and 3, the outer end 128b of the adjustment pin 128 is arranged to receive an allen key, screwdriver, tool or the like which enables ready rotation of the adjustment pin 128. Alternatively, the adjustment pin 128 may be slideable in a direction perpendicular to the longitudinal axis of the thermostatic element 26 and configured so that movement of the adjustment pin 128 will cause movement of the thermostatic element 26 in a direction towards or away from the hot inlet 16. In this manner the rest position of the thermostatic element 26 can be varied and thus the set temperature of the outlet fluid varied.

The mixing valve 100 shown in Figures 2 and 3 is particularly advantageous because the adjustment mechanism 128 of the valve 100 can be easily adjusted once the mixing valve 100 is installed. Adjustment can be achieved simply and quickly.

The described embodiments of the invention are considered to be particularly advantageous because they enable the set temperature of the outlet fluid of the thermostatic mixing valve to be readily varied, whilst minimizing any additional components or manufacture costs. It will also be appreciated that in the event that the thermostatic element 26 continues to expand, the piston arrangement

22 is configured so that the valve 32 will absorb any over travel of the thermostatic element 26.

The embodiments have been described with reference to an "L" shaped thermostatic mixing valve. However, it will be appreciated, that the invention has application in thermostatic mixing valves of various configurations.

The embodiments have been described by way of example only and modifications within the spirit and scope of the invention are envisaged.

DATED: 6 June 2003
PHILLIPS ORMONDE & FITZPATRICK
Attorneys for:
GSA INDUSTRIES (AUST) PTY LTD

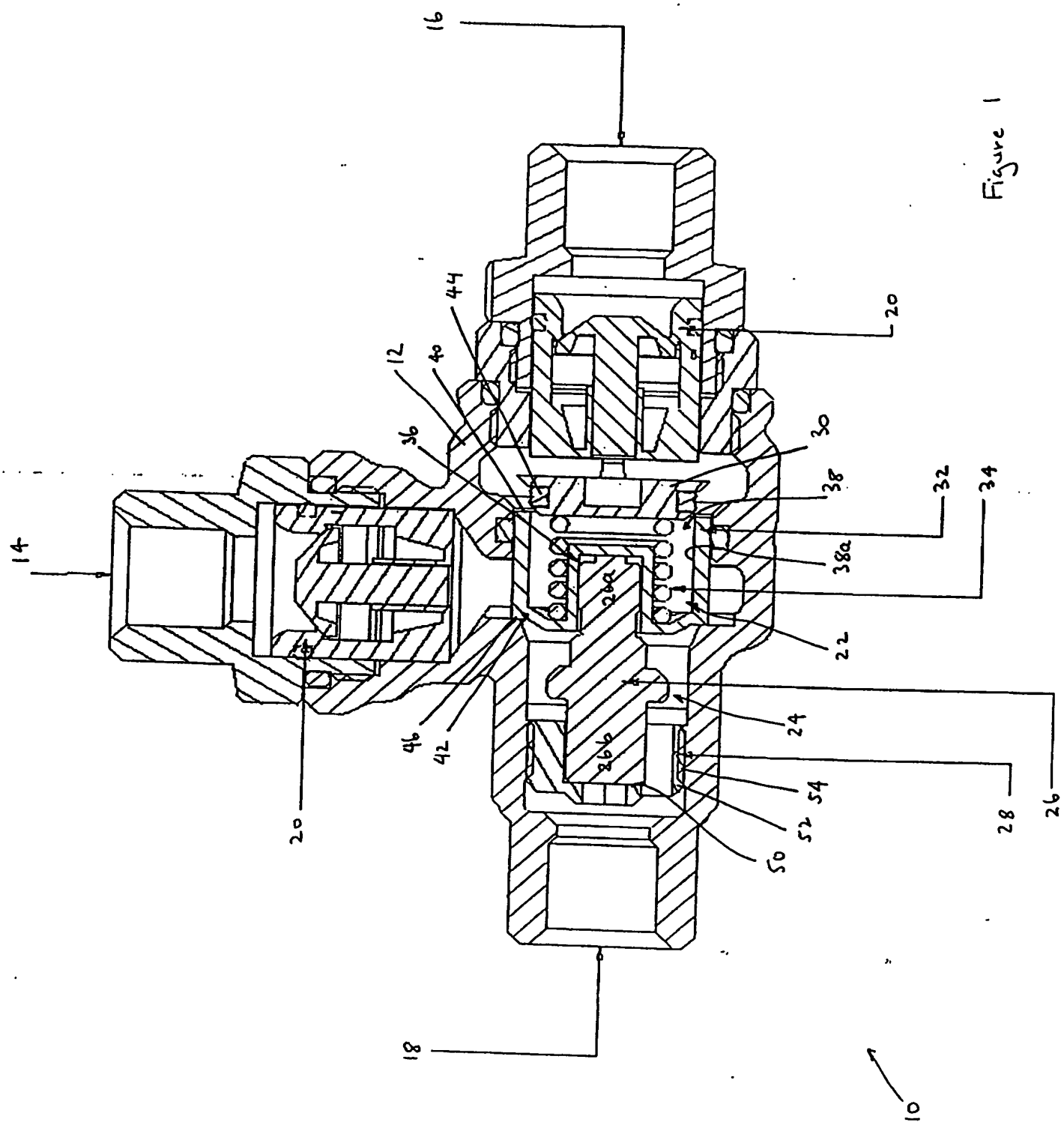

Figure 1

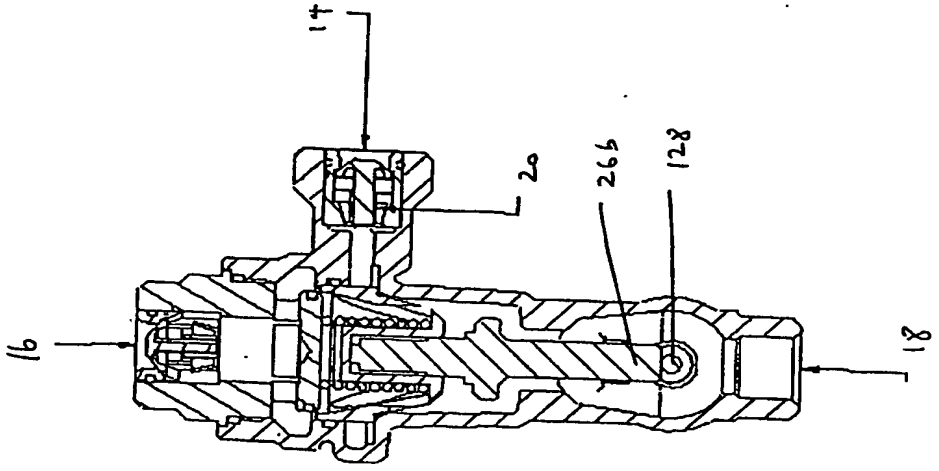

Figure 3

100

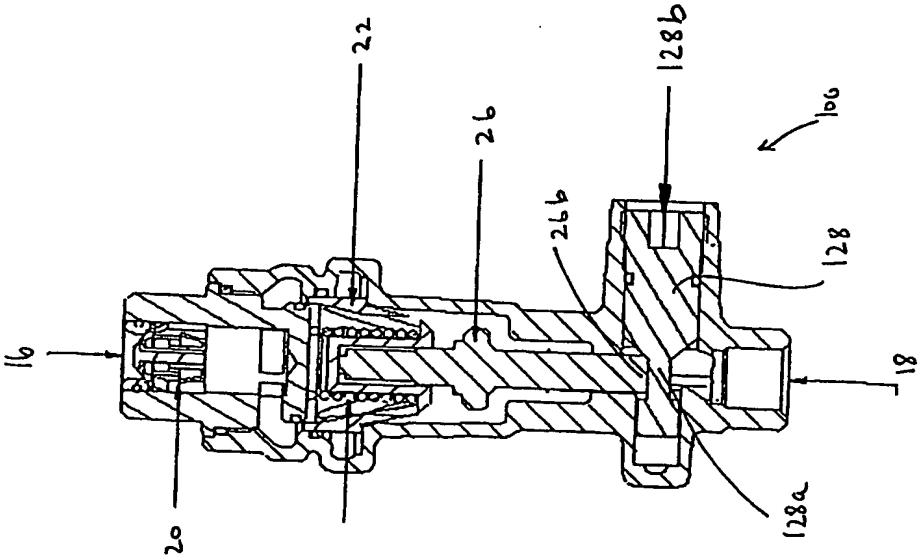

Figure 2